CLAIMS

What is claimed is:

1. A deinterlacing apparatus, comprising:

a buffer unit having a previous field buffer, a current field buffer, and a next field buffer to store, sequentially, individual fields of an image signal which are successively inputted;

a zero motion estimation unit to calculate a Sum of Absolute Difference (SAD) value by a predetermined search region unit with reference to a next field stored in the next field buffer and a previous field stored in the previous field buffer;

a still region/film mode detection unit to determine whether the predetermined search region is a still region and whether a source of the image signal is a film based on the SAD value;

a 3D interpolation unit to output adaptively a temporal interpolation value and a spatial interpolation value based on motion information; and

an adaptive selection unit to output a deinterlacing result based on the previous field, the next field, and an output of the 3D interpolation unit according to a signal outputted from the still region/film mode detection unit.

2. The apparatus as claimed in claim 1, wherein the search region is a macro block having a predetermined size, and the zero motion estimation unit calculates the SAD value based on a following formula:

$$SAD = \sum \{(x, y) \in B\} \mid f(x, y, t - 1) - f(x, y, t + 1) \mid,$$

wherein B is a sum of (x,y) indices corresponding to pixels inside the macro block and t represents time.

3. The apparatus as claimed in claim 1, wherein the still region/film mode detection unit comprises:

a still region decision unit to determine whether the predetermined search region is the still region or a motion region based on the SAD value;

a film mode detection unit to determine whether the source of an image signal is the film based on a result of a determination of the still region decision unit; and

a multiplexing unit to output one of outputs of the still region decision unit and the film mode detection unit corresponding to results of determinations of the still region decision unit and the film mode detection unit.

4. The apparatus as claimed in claim 3, wherein the still region decision unit includes:

a decision unit to compare the SAD value with a predetermined threshold value and determining whether the predetermined search region is the still region;

a decision buffer to store a result of the decision of the decision unit; and

a precision decision unit to output a signal indicating whether the predetermined search region is the still region based on results of the determinations on the predetermined search region and an ambient search region thereof stored in the decision buffer.

5. The apparatus as claimed in claim 4, wherein the decision unit determines that the predetermined search region is the still region when the SAD value is smaller than the predetermined threshold value and is the motion region when the SAD value is larger than the predetermined threshold value.

6. The apparatus as claimed in claim 1, wherein the 3D interpolation unit includes:

a temporal interpolation unit to insert lines of the previous and next fields corresponding to intermediate lines of a current field and performing interpolations;

a spatial interpolation unit to insert data obtained by dividing data of two lines by two in an area between the two lines of the current field for interpolations;

a motion information extraction unit to extract motion information between the previous field and the next field with reference to the current field; and

a soft switching unit to mix outputs of the temporal interpolation unit and the spatial interpolation unit adaptively to generate an output based on the motion information.

7. A deinterlacing apparatus, comprising:

a buffer unit having a previous field buffer, a current field, and a next field buffer and to store, sequentially, lines of each of fields of an image signal which are successively inputted;

a zero motion estimation unit to calculate a Sum of Absolute Difference (SAD) value based on lines of the next field stored in the next field buffer and lines of the previous field stored in the previous field buffer;

a still region/film mode detection unit to determine whether a predetermined search region is a still region and whether a source of the image signal is a film, based on the SAD value;

a 3D interpolation unit to output, adaptively, a temporal interpolation value and a spatial interpolation value based on motion information; and

an adaptive selection unit to output a deinterlacing result based on outputs of the previous field, the next field, and the 3D interpolation unit according to an output signal of the still region/film mode detection unit.

8. The deinterlacing apparatus as claimed in claim 7, wherein the zero motion estimation unit includes:

a segment SAD calculation unit to calculate segment SAD values with respect to lines of a predetermined size;

an SAD buffer unit to store the segment SAD values calculated from the segment SAD calculation unit; and

a block SAD calculation unit to add the segment SAD values stored in the SAD buffer unit to calculate an SAD value.

9. The deinterlacing apparatus as claimed in claim 8, wherein the segment SAD calculation unit calculates the segment SAD values based on a following formula with respect to the lines of a predetermined size:

$$SAD = \sum \{(x) \in L\} \, | \, f(x,y,t-1) - f(x,y,t+1) \, |,$$

wherein L is a sum of x indices corresponding to pixels in a predetermined macro block, (x, y) indices correspond to pixels inside the macro block, and t represents time.

10. The deinterlacing apparatus as claimed in claim 7, wherein the still region/film mode detection unit includes:

a still region decision unit to determine whether the predetermined search region is the still region or the motion region based on the SAD value;

a film mode detection unit to determine whether the source of the image signal is a film based on a result of the decision of the still region; and

a multiplexing unit to output any one of outputs of the still region decision unit and the film mode detection unit corresponding to results of determinations of the still region decision unit and the film mode detection unit.

11. The deinterlacing apparatus as claimed in claim 10, wherein the still region decision unit includes:

a decision unit to compare the SAD value with a predetermined threshold value and to determine whether the predetermined search region is the still region;

a decision buffer to store a result of a determination of the decision unit; and

a precision decision unit to output a signal indicating whether the predetermined search region is the still region based on results of determinations on the predetermined search region and an ambient search region thereof stored in the decision buffer.

12. The deinterlacing apparatus as claimed in claim 11, wherein the decision unit determines that the predetermined search region is the still region if the SAD value is smaller than the predetermined threshold value, and determines that the predetermined search region is the motion region if the SAD value is larger than the predetermined threshold value.

13. The deinterlacing apparatus as claimed in claim 7, wherein the 3D interpolation unit includes:

a temporal interpolation unit to insert the previous and next field lines corresponding to intermediate lines of the current field for interpolations;

a spatial interpolation unit to insert data obtained from dividing data of two lines of the current field by two in a region between the two lines for interpolations;

a motion information extraction unit to extract motion information between the previous field and the next field with reference to the current field; and

a soft switching unit to mix, adaptively, outputs of the temporal interpolation unit and the spatial interpolation unit based on the motion information for an output.

14. A deinterlacing method, comprising :

storing sequentially a previous field, a current field, and a next field of an image signal which are successively inputted;

calculating a Sum of Absolute Difference (SAD) value by a predetermined search region unit with reference to the next field and the previous field;

determining whether the predetermined search region is a still region and whether a source of the image signal is a film based on the SAD value;

outputting adaptively a temporal interpolation (TI) value and a spatial interpolation (SI) value based on motion information; and

outputting a deinterlacing result based on the previous field, the next field, the TI value and the SI value according to whether the predetermined search region is the still region and whether the source of the image signal is the film.

15. The deinterlacing method as claimed in claim 14, wherein the search region is a macro block having a predetermined size, and the calculating of the SAD value is based on a following formula:

$$SAD = \sum \{(x, y) \in B\} \mid f(x, y, t - 1) - f(x, y, t + 1) \mid,$$

wherein B is a sum of (x,y) indices corresponding to pixels inside the macro block and t represents time.

16. The deinterlacing method as claimed in claim 14, wherein determining whether the predetermined search region is the still region and whether the source of the image signal is the film comprises:

determining whether the predetermined search region is the still region or a motion region based on the SAD value;

determining whether the source of the image signal is the film based on a result of whether the predetermined search region is the still region or the motion region; and

outputting an output in correspondence with a still region determination, a motion region determination and a film determination.

17. The deinterlacing method as claimed in claim 16, wherein determining whether the predetermined search region is the still region or the motion region based on the SAD value comprises:

comparing the SAD value with a predetermined threshold value and determining whether the predetermined search region is the still region; and

outputting a signal indicating whether the predetermined search region is the still region based on results of determination values of the predetermined search region and an ambient search region thereof which are stored.

18. The deinterlacing method as claimed in claim 17, including determining that the predetermined search region is the still region when the SAD value is smaller than the predetermined threshold value, and is the motion region when the SAD value is larger than the predetermined threshold value.

19. The deinterlacing method as claimed in claim 14, wherein outputting adaptively the TI value and the SI value comprises:

inserting lines of the previous and next fields corresponding to intermediate lines of a current field and performing interpolations;

inserting data obtained by dividing data of two lines by two into an area between the two lines of the current field for interpolations;

extracting motion information between the previous and next fields with reference to the current field; and

mixing adaptively line interpolation outputs and extracted motion information outputs to generate an output based on the motion information.

20. A deinterlacing method, comprising :

storing sequentially lines of each of a previous field, a current field, and a next field of an image signal which are successively inputted;

calculating a Sum of Absolute Difference (SAD) value based on lines of the next field and lines of the previous field;

determining whether a predetermined search region is a still region and whether a source of the image signal is a film, based on the SAD value;

outputting adaptively a temporal interpolation (TI) value and a spatial interpolation (SI) value based on motion information; and

outputting a deinterlacing result based on outputs of the lines of the previous and next fields, the TI value and the SI value and according to a result of the determining whether the predetermined search region is the still region and whether the source of the image signal is the film, based on the SAD value.

21. The deinterlacing method as claimed in claim 20, wherein the calculating of the SAD value comprises:

calculating segment SAD values with respect to lines of a predetermined size;

storing the segment SAD values; and

adding the stored segment SAD values to calculate an SAD value.

22. The deinterlacing method as claimed in claim 21, wherein the calculating of the segment SAD values with respect to lines of the predetermined size includes calculating the

segment SAD values based on a following formula with respect to the lines of a predetermined size:

$$SAD = \sum \{(x) \in L\} \mid f(x,y,t-1) - f(x,y,t+1) \mid,$$

wherein L is a sum of x indices corresponding to pixels in a predetermined macro block, (x,y) are indices corresponding to pixels inside the macro block, and t represents time..

23. The deinterlacing method as claimed in claim 20, wherein the determining whether the predetermined search region is the still region and whether the source of the image signal is the film comprises:

determining whether the predetermined search region of the current field is the still region or the motion region based on the SAD value;

determining whether the source of the image signal is a film based on a result of a determination whether the predetermined search region of the current field is the still region or the motion region based on the SAD value; and

outputting one of a still region determination, a motion region determination and a film determination based on the determinations.

24. The deinterlacing method as claimed in claim 23, wherein determining whether the predetermined search region of the current field is the still region or the motion region based on the SAD value comprises:

comparing the SAD value with a predetermined threshold value and determining whether the predetermined search region is the still region; and

outputting a signal indicating whether the predetermined search region is the still region based on results of determinations on the predetermined search region and an ambient search region thereof which are stored.

25. The deinterlacing method as claimed in claim 24, including determining that the predetermined search region is the still region if the SAD value is smaller than the predetermined threshold value, and is the motion region if the SAD value is larger than the predetermined threshold value.

26. The deinterlacing method as claimed in claim 20, wherein outputting the TI value and the SI value comprises:

inserting the previous and next field lines corresponding to intermediate lines of the current field for interpolations;

inserting data obtained from dividing data of two lines of the current field by two in a region between the two lines for interpolations;

extracting motion information between the previous and next fields with reference to the current field; and

mixing adaptively line interpolation outputs and extracted motion information outputs based on the motion information for an output.

27.   A computer-readable medium having stored thereon computer-executable instructions to deinterlace image signals, the computer-executable instructions comprising:

storing sequentially a previous field, a current field, and a next field of an image signal which are successively inputted;

calculating a Sum of Absolute Difference (SAD) value by a predetermined search region unit with reference to the next field and the previous field;

determining whether the predetermined search region is a still region and whether a source of the image signal is a film based on the SAD value;

outputting adaptively a temporal interpolation (TI) value and a spatial interpolation (SI) value based on motion information; and

outputting a deinterlacing result based on the previous field, the next field, the TI value and the SI value according to whether the predetermined search region is the still region and whether the source of the image signal is the film.

28. The computer-readable medium as claimed in claim 27, wherein the search region is a macro block having a predetermined size, and calculating the SAD value is based on a following formula:

$$SAD = \sum \{(x,y) \in B\} \mid f(x,y,t-1) - f(x,y,t+1) \mid,$$

wherein the B is a sum of (x,y) indices corresponding to pixels inside the macro block and t represents time.

29. The computer-readable medium as claimed in claim 27, wherein the determining whether the predetermined search region is the still region and whether the source of the image signal is the film comprises:

determining whether the predetermined search region is the still region or a motion region based on the SAD value;

determining whether the source of the image signal is the film based on a result of whether the predetermined search region is the still region or the motion region; and

outputting an output in correspondence with a still region determination, a motion region determination and a film determination.

30. The computer-readable medium as claimed in claim 29, wherein determining whether the predetermined search region is the still region or the motion region based on the SAD value comprises:

comparing the SAD value with a predetermined threshold value and determining whether the predetermined search region is the still region; and

outputting a signal indicating whether the predetermined search region is the still region based on results of determination values of the predetermined search region and an ambient search region thereof which are stored.

31. The computer-readable medium as claimed in claim 30, including determining that the predetermined search region is the still region when the SAD value is smaller than the predetermined threshold value, and is the motion region when the SAD value is larger than the predetermined threshold value.

32. The computer-readable medium as claimed in claim 27, wherein outputting adaptively the TI value and the SI value comprises:

inserting lines of the previous and next fields corresponding to intermediate lines of a current field and performing interpolations;

inserting data obtained by dividing data of two lines by two into an area between the two lines of the current field for interpolations;

extracting motion information between the previous and next fields with reference to the current field; and

mixing adaptively line interpolation outputs and extracted motion information outputs to generate an output based on the motion information.

33. A computer-readable medium having stored thereon computer-executable instructions to deinterlace image signals, the computer-executable instructions comprising:

storing sequentially lines of each of a previous field, a current field, and a next field of an image signal which are successively inputted;

calculating a Sum of Absolute Difference (SAD) value based on lines of the next field and lines of the previous field;

determining whether a predetermined search region is a still region and whether a source of the image signal is a film, based on the SAD value;

outputting adaptively a temporal interpolation (TI) value and a spatial interpolation (SI) value based on motion information; and

outputting a deinterlacing result based on outputs of the lines of the previous and next fields, the TI value and the SI value and according to a result of the determining whether the predetermined search region is the still region and whether the source of the image signal is the film, based on the SAD value.

34. The computer-readable medium as claimed in claim 33, wherein the calculating of the SAD value comprises:

calculating segment SAD values with respect to lines of a predetermined size;

storing the segment SAD values; and

adding the stored segment SAD values to calculate an SAD value.

35. The computer-readable medium as claimed in claim 34, wherein the calculating of the segment SAD values with respect to lines of the predetermined size includes calculating the segment SAD values based on a following formula with respect to the lines of a predetermined size:

$$SAD = \sum \{(x) \in L\} \mid f(x,y,t-1) - f(x,y,t+1) \mid,$$

wherein L is a sum of x indices corresponding to pixels in a predetermined macro block, (x,y) are indices corresponding to pixels inside the macro block, and t represents time..

36. The computer-readable medium as claimed in claim 33, wherein determining whether a predetermined search region is the still region and whether the source of the image signal is the film comprises:

determining whether the predetermined search region of the current field is the still region or the motion region based on the SAD value;

determining whether the source of the image signal is a film based on a result of a determination whether the predetermined search region of the current field is the still region or the motion region based on the SAD value; and

outputting one of a still region determination, a motion region determination and a film determination based on the determinations.

37. The computer-readable medium as claimed in claim 36, wherein determining whether the predetermined search region of the current field is the still region or the motion region based on the SAD value comprises:

comparing the SAD value with a predetermined threshold value and determining whether the predetermined search region is the still region; and

outputting a signal indicating whether the predetermined search region is the still region based on results of determinations on the predetermined search region and an ambient search region thereof which are stored.

38. The computer-readable medium as claimed in claim 37, including determining that the predetermined search region is the still region if the SAD value is smaller than the predetermined threshold value, and is the motion region if the SAD value is larger than the predetermined threshold value.

39. The computer-readable medium as claimed in claim 33, wherein outputting the TI value and the SI value includes:

inserting the previous and next field lines corresponding to intermediate lines of the current field for interpolations;

inserting data obtained from dividing data of two lines of the current field by two in a region between the two lines for interpolations;

extracting motion information between the previous and next fields with reference to the current field; and

mixing adaptively line interpolation outputs and extracted motion information outputs based on the motion information for an output.